Chapter 4. The Roles and Responsibilities of Chemical Engineers

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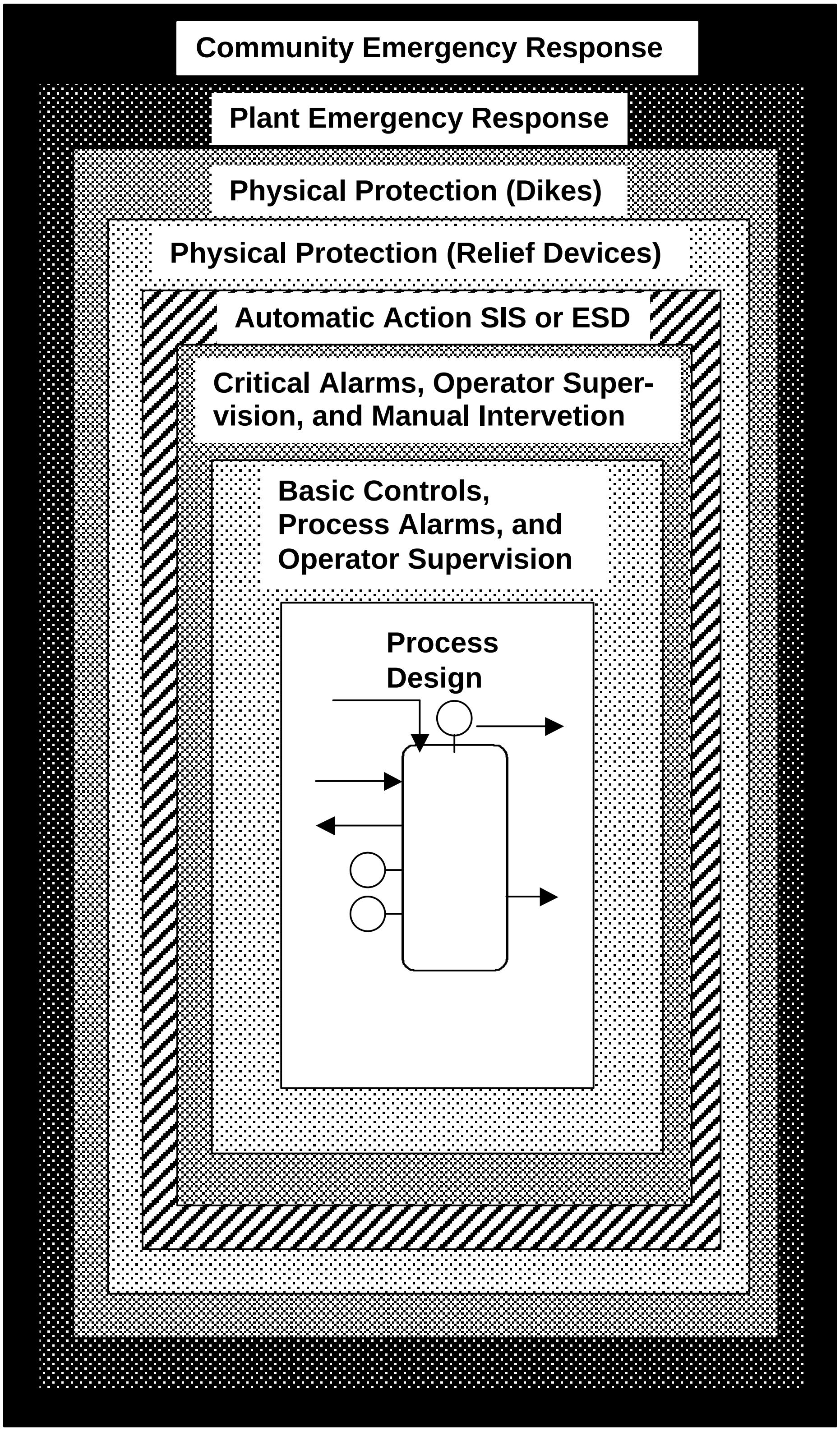
Many chemical engineers design and operate large-scale and complex chemical production facilities to supplying diverse chemical products to society. In performing these functions, a chemical engineer will likely assume a number of roles during a career. The engineer may become involved in raw materials extraction, intermediate materials processing, or production of pure chemical substances; in each activity, the minimization and management of waste stream will have important economic and environmental consequences. Chemical Engineers are involved in the production of bulk and specialty chemicals, petrochemicals, integrated circuits, pulp and paper, consumer products, minerals, and pharmaceuticals. Chemical engineers also find employment in research, consulting organizations, and educational activities. The engineer may perform functions such as process and production engineering, process design, process control, technical sales and marketing, community relations, and management.

As engineers assume such diverse roles, it is increasingly important that they be aware of their responsibilities to the general public, colleagues and employers, the environment, and also to their profession. One of the central roles of chemical engineers is to design and operate chemical processes yielding chemical products that meet customer specifications and that are profitable. Another important role is to maintain safe conditions for operating personnel and for residents in the immediate vicinity of a production facility. Finally, chemical process designs need to be protective of the environment and of human health. Environmental issues must be considered not only within the context of chemical production but also during other stages of a chemical's life cycle, such as transportation, the use of chemicals by customers, recycling activities, and ultimate disposal.

This chapter introduces approaches to designing safe chemical processes (Section 4.2). The point of briefly introducing this important topic is to demonstrate that the evolution of the methods used to design safe processes mirrors the evolution of methods described in this text, which are used to design processes that minimize environmental impacts. Section 4.3 reviews, in slightly more detail, the types of procedures that will be used in designing processes that minimize environmental impacts, and the responsibilities of chemical engineers to reduce pollution generation within chemical processes. Section 4.4 briefly notes some of the other professional responsibilities of chemical engineers, i.e., issues dealing with engineering ethics.

Chapter 4 Example Figure Typical layers of protection for a chemical plant (CCPS 1993b, Crowl 1996). SIS is safety interlock system and ESD is emergency shutdown.



Chapter 4 Sample Homework Problem

1. Flammability Limits
A vertical fixed-roof storage tank contains pure toluene liquid at a temperature of 25°C in contact with air at the same temperature. The saturation vapor pressure of toluene at this temperature is 0.0374 atm. Assume that the partial pressure of toluene vapor in the air above the liquid achieves this saturation value. You can consider the vapor/air mixture to be an ideal gas. The volume percent of toluene in air can be given by;

$$Vol\,\% = .08205 \times 10^{-4} \left(\frac{T}{M\,P} \right) C_{Toluene}$$

where T is absolute temperature (K), P is absolute pressure of the air (1 atm), M is the molecular weight of toluene (92.1 g/mole), and $C_{Toluene}$ is the concentration of toluene expressed in mass units (mg toluene/m^3 air).

a) Is the toluene/air mixture a flammability hazard?

b) Below what temperature would the toluene in the storage tank have to be cooled in order that the toluene/air mixture is below the LFL?